As a Principal Investigator for 6 separate National Science Foundation Wireless Projects between 1995 and 2003, in which the NSF awarded my company – Old Colorado City Communications – over $2 million in grants to model 'wireless' for the retrieval of data from remote and rural data logging sites by environmental and biological scientists, I am fully qualified to comment on the deficiencies of radios operating under current unlicensed rules to support important field science in remote and rural areas of the US, wirelessly.

For the past 8 years we have, under NSF grants to 'explore the uses of wireless in field science' deployed unlicensed radios to attempt to bridge the distance between field stations, and the places data loggers are deployed, gathering, over long terms (1 to 5 years) environmental and biological data. Until recently all such data loggers had to be tended manually, with repeated visits by those attempting to collect data, at considerable labor and support costs, and in many cases impossible during winter. Only with the advent of unlicensed wireless has it been possible to set up networks, connecting such data loggers back, not only to field stations, but through it, to the Internet, so Research Scientists around the world can 'collect' the data and monitor their experiments real time.

The problems are rarely bandwidth issues. It is common to need only 9.6k bandwidth for data, or 384kbps bandwidth for video from CAMs. But invariably these data collecting stations have to be in wooded, or vegetation covered areas. Reach such loggers through trees and vegetation wirelessly is a major, major problem.

There is a particular problem in linking data loggers which are in woods or other vegetated areas, in that terrestrial unlicensed radios in either the 902-928Mhz or 2.4-2.483 bands cannot penetrate far enough to be fully useful. Yet in our experience supporting the environmental field research of scientists whose field stations are near the Universities of Puerto Rico, Wisconsin, Virginia, Alaska, New Mexico data loggers inevitably have to be placed in remote areas which are wooded or surrounded by signal-blocking vegetation. Since there is a direct relationship between the penetrating capability of electromagnetic signals through trees, vegetation, or artificial structures, and the frequency of the signal as well as its strength, the lower the frequency the greater the number of data logging stations can be reached, interactively, wirelessly, and in real time, rather than by primitive manual data collection methods. Ironically, television signals were originally placed in the 700Mhz frequency ranges BECAUSE they could penetrate buildings whose television set owners used small internal antennas inside the buildings. Of course television broadcast is utterly useless for the purposes of gathering data, from not only built up areas, but remote areas where there ARE no television set users.

Thus FCC rules which permitted radio operations below 900Mhz would permit much broader wireless data gathering essential to field science trying to measure critical environmental facts and long term trends in such matters as global warming, change in biological species habitats, effects of pollution on natural areas

At the same time these areas are commonly so far from cities or towns or other human habitation that there are simply no issues of potential interference. In the case of Alaska, most the data logging sites are far beyond the range of ANY television signals.

Therefore an FCC proposal to permit the unlicensed use of spectrum, under controlled conditions, currently allocated to urban-centered television broadcast, would be boon to field sciences which are becoming ever more important to our national health and welfare. And any FCC rule that permits more EIRP power to lower frequencies would be embraced by thousands of field scientists.

The potential to create 'interference' of other radios is absolutely minimal in the vast majority of field science data gathering areas. Never, in 6 years of deploying radios in central Alaska, Puerto Rico, Wisconsin, or Chesapeake Bay has there been a complaint, much less detection by our spectrum data logger of interference. We are talking about REMOTE science, whose data gathering findings are some of the only ways we will know how healthy or sick is our natural environment, assaulted as it is by all manner of human activities.

While the last thing the FCC would think about as a 'wireless constituency' are the tens of thousands of University field researches working in remote areas from off shore islands, to lake country in northern climes, forests of the West, and rain forests. Unlicensed wireless can aid in this work immeasurably if the FCC rules permit manufacturers to build radios that can use such radios.

Fifty six experiments are online at http://wireless.oldcolo.com which can illustrate both the experience, and needs for Environmental and Biological Science. (which itself is funded in the hundred's of millions of dollars by the NSF)

Below I append the text of a Filing in 2002 that was made by Dr. Timothy Kratz, University of Wisconsin on Docket item 02-135 in an attempt to get greater than 4watts EIRP signal strength at 915Mhz unlicensed to permit his radios to 'punch through' the forests which surround the thousands of Northern Wisconsin lakes which have been the object of study since 1924, and will continue to be researched backed by NSF grants for decades to come. It illustrates, directly from credible research scientists the need for FCC spectrum use rules to support field science.

David R Hughes
Principal Investigator
National Science Foundation Wireless Field Science Projects 1995-2003

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13 June 2002

Federal Communications Commission
445 12th Street, SW
TW-A325
Washington, DC 20554
Attn: Marlene H. Dortch

Dear Sir or Madam,

Please accept this comment on spectrum policy, ET Docket No. 02-135, for the Spectrum Policy Task Force.

I am the Director of the University of Wisconsin Trout Lake Station, a field research station operated by the Center for Limnology, University of Wisconsin-Madison. I appreciate this opportunity to discuss how current spectrum policy influences and restricts our ability to do field science, particularly in the critical area of environmental monitoring. My comments appear most directly relevant to questions 3b and 5 in the Public Notice released 6 June 2002.

Careful, near real-time monitoring of the environment for climate, hydrology, air and water chemistry, and biota has been an increasingly important activity for many Biological Field Stations in the past decade. For the past several years, researchers at the UW Trout Lake Station have placed instrumented buoys on lakes to monitor various physical, chemical, and biological properties of lakes in near real-time. These data have been transferred from the buoys to our field station (and then made available on the internet) using unlicensed Part 15

rule radios operating in the 915mhz and 2.4ghz bands. Under current rules these radios are limited to a maximum of 4 Watts at the antenna regardless of location. This power restriction severely limits our ability to monitor the environment because the range of these radios is quite small in our setting.

The Trout Lake Station is located in the forested Northern Highlands Lake District in rural northern Wisconsin. This lake district contains about 2500 lakes in an area roughly bounded by a circle 100 miles in diameter. Using Freewave spread spectrum radios operating at full, legal power in the 915mhz band we find that we can communicate a maximum distance of 3 miles from a 130-foot tower at our base station to instrumented buoys on lakes. The limited ability of our radios to penetrate through vegetation requires us to use an unwieldy and expensive system of relays to collect data in near real-time from lakes as close as 5 miles from the field station. This situation currently inhibits our federally-funded scientific research into such areas as effects of climate change, land-use change, and spread of exotic species on aquatic resources. This lack of radio range is unacceptable logistically and unnecessary from a policy perspective.

A simple change in FCC policy could help greatly. In this rural environment, interference in these unlicensed bands is not an issue, but range most certainly is. It seems reasonable to provide for different power maxima in rural vs. urban areas. For example, we believe that changing the total power at the antenna from the current maximum of 4 watts to 10 watts or more in rural areas would allow our radios to punch much further through trees and brush, without detrimental effects to other users.

Because lower frequencies penetrate through trees, brush and walls more effectively, making lower frequencies available in the unlicensed spread spectrum bands would also greatly facilitate field science in rural areas.

In the future, whether for homeland security or informed public policy on pressing resource management issues, environmental measurements made at scientific field stations in rural areas will become more and more important. State-of-the-art environmental monitoring requires the use of remotely-deployed sensors attached to data loggers and radios. As these sensors become smaller, smarter, and cheaper their use and importance will only increase. There are several currently-funded or proposed large-scale programs of the National Science Foundation that will greatly benefit from more effective use of wireless communication with remotely-deployed sensors. These programs include the Long Term Ecological Research program (which currently funds research at 25 mostly rural locations across the U.S and Antarctica) and the proposed National Environmental Observatory Network. It is crucial that the FCC implements spectrum use policy that allows reasonable communication from field stations to field-deployed sensors in rural areas.

Thank you for consideration of these comments.

Sincerely,

Tim Kratz, Ph.D
Director, University of Wisconsin Trout Lake Station

David R Hughes
PI

dave@oldcolo.com